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LENGTH FREQUENCY DISTRIBUTION OF *Ethmalosa fimbriata* (BOWDICH) IN CROSS RIVER ESTUARY AND ADJACENT COASTAL WATERS

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ABSTRACT

Studies on the length distribution of bonga, *Ethmalosa fimbriata*, in the Cross River estuary and adjacent coastal waters were conducted from October 1999 to December 2000. A total of 15,182 specimens of bonga from gill nets, purse seine and boat seine fisheries were measured. Post-larvae measuring between 2 cm and 9 cm were found in the lower estuary with a modal length of 4 cm. Juveniles from gill net fishery ranged in length from 8 cm to 20 cm with a modal length of 13cm. Adults and sub-adults ranging in size from 16 cm to 33 cm were caught from the coastal waters alongside the juveniles, by the purse seine fishery. Two modal lengths of 17 cm and 25 cm were observed in the coastal waters. Three modal length classes were observed in the catches from the Cross River estuary and adjacent coastal waters: these are 4 cm, 13 cm and 25 cm. It is concluded that the Cross River estuary is a nursery ground for bonga, *Ethmalosa fimbriata*.

Keywords: *Ethmalosa fimbriata*, length distribution, Cross River estuary, coastal waters, nursery.

INTRODUCTION

Cross River estuary is the largest estuary in the Gulf of Guinea (Moses, 1988), occupying a total of 54,000 km^2 (Akpan and Offem, 1991). It has a high level of biodiversity, supporting a wide variety of fish species. Fish species numbering up to 28 families were encountered by Uwe-Bassey,(1988). Enin, *et al* (2000), encountered 19 fish genera and at least 21 fish species. These included *Pseudotolithus elongatus*, *Chrysichthys nigrodigitatus*, and *Ethmalosa fimbriata*.

Ethmalosa fimbriata accounts for between 18-23 per cent of the artisanal fish landings in the Cross River Estuary (Moses, 1988; Enin, *et al*, 2000), ranking second to *Pseudotolithus elongatus*. There are three main fisheries exploiting the bonga resources along the length of the estuary. These are the gill net, the purse seine and the boat seine fisheries. The artisanal gill net fishery of bonga occurs in the inner estuary and is seasonal, taking place in the dry season from November to May or early June. The boat seine exploits the resources in the outer estuary around Ibaka or James Town (Fig 1), between the month of November and May. (Ama-Abasi and Holzloehner, 2000). The purse seine traditionally exploits the resources in the coastal waters all year round and in the dry season penetrates additionally into the estuary at the peak of bonga season.

Very scanty information exists on the bonga resources of the Cross River Estuary and nothing is known about the resources in coastal waters. It is the objective of the present work to analyze length frequency distribution of the *E. fimbriata* along the entire spread of the Estuary and the coastal waters with a view to assessing the role of the estuary in the life history of the species. Such information is also needed as a baseline for the study of population biology of the species.

MATERIALS AND METHODS

Sampling was conducted between October 1999 and December 2000. The sampling sites are shown in figure 1. The sampling sites cover the Cross River estuary from Calabar to Ibaka and beyond. Sampling was done in inner Cross River estuary with the gill net boats with settlement at Parrot Island, based on trips with the research boat of the Institute of Oceanography. The gill net had an average mesh size of 40 mm stretched diagonally. In the outer estuary sampling was done in Ibaka from the boat seine. The boat seine has very fine mesh size of about 1-2 mm. Sampling from purse seine was done either at Ibaka after landing or on waters of the inner estuary as the purse seine boats were encountered. The purse seine also has a very fine mesh size of about 2-5 mm. Fish samples from the coastal waters came solely from catches by the purse seine fishery after landing at Ibaka.

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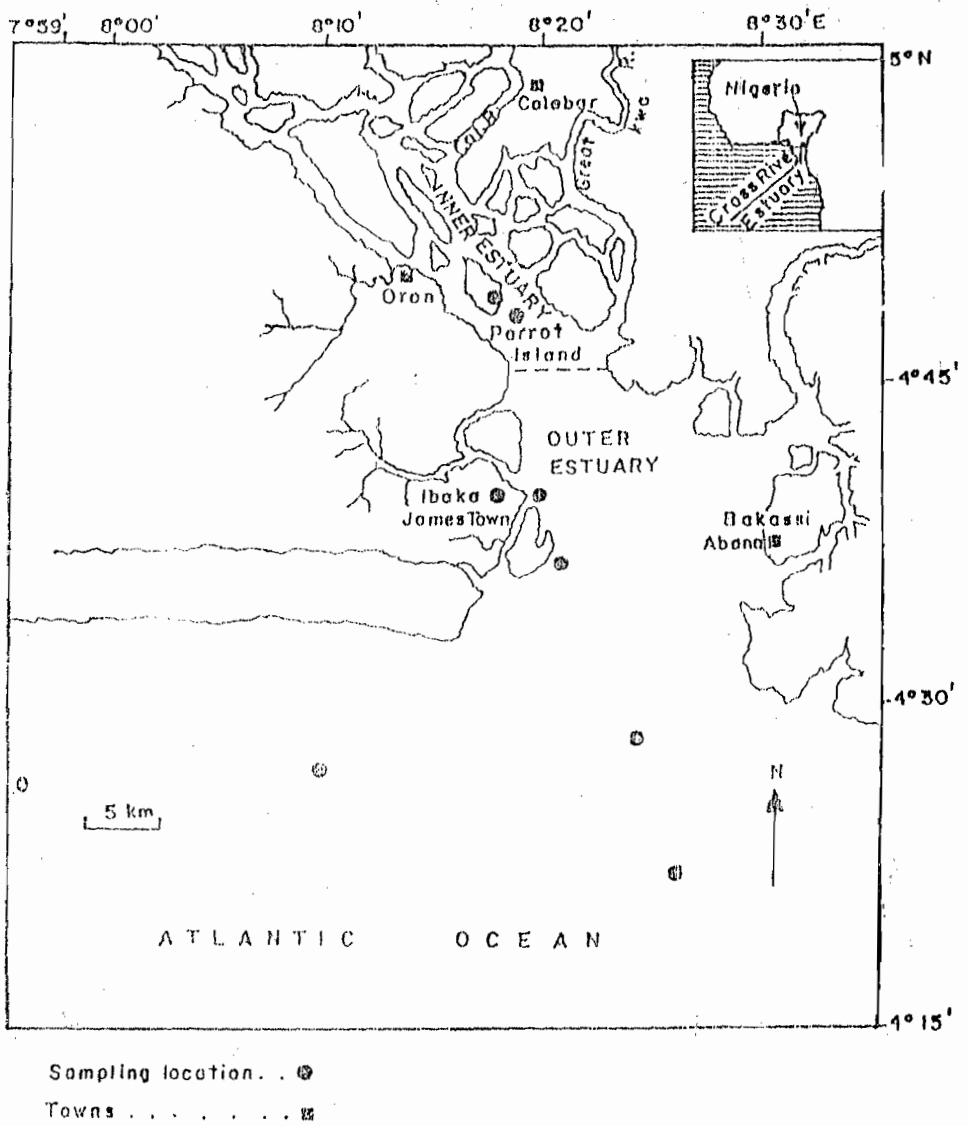

Fig. 1: Cross River estuary and its adjacent coastal waters showing the area of study.

Fish samples were measured to the nearest centimeter using a measuring board. About 200 individuals of bonga were measured during each trip. A total of 15,182 specimens of bonga, *E.fimbriata*, comprising 5997 individuals from the boat seine, 7051 individuals from purse seine fishery and 2134 individuals from gill net fishery. Frequencies were obtained by calculation of percentage occurrence of the individual sizes. The salinity and temperature of the surface water was taken on each visit.

RESULTS

The size composition of bonga from the boat seine ranged from 2.0 cm to 9.0 cm. The modal class was 4 cm size group with frequency of 40.7%. The 2 cm group had a frequency of 7.7 % while the 9 cm group had a frequency of 0.2 % (Fig 2)

The size composition of bonga from the gill net fishery ranged from 8cm to 19 cm. The modal class was 13.0 cm with a frequency of 27.2 %. The 8 cm and 19 cm size classes both had frequency of 0.1% (Fig 3). The size composition of samples from the purse seine in the inner estuary ranged from 8.0 cm to 20.0 cm with a modal class at 11cm and frequency of 15.7 %. The 8.0 cm group had a frequency of 0.2 % while the 20cm size class had a frequency of 0.2%. (Fig. 4).

A pooled data from the purse seine, gill net and boat seine fisheries, which make up catches from the estuary, is given in Fig.5. As shown in the

figure, the samples comprised predominantly individuals from 2 cm to 20 cm. There were two clear modal classes of 4 cm and 13 cm. The 13 cm group had a frequency of 8.2 % while the 2 cm group had a frequency of 4 % and 20 cm group had a frequency of 0.1

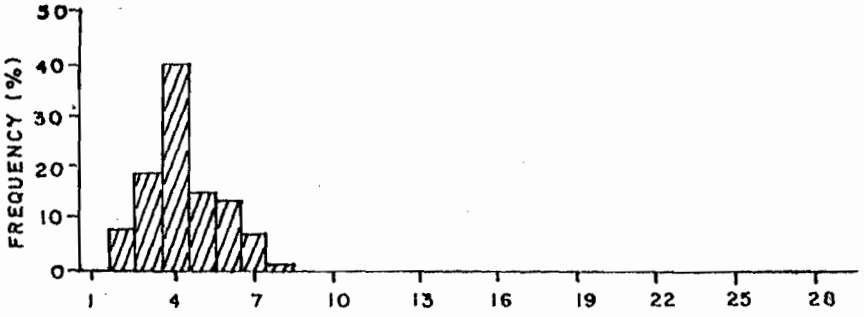

Fig. 2 : Length frequency distribution of Ethmalosa fimbriata from boat seine fishery in the outer Cross River estuary

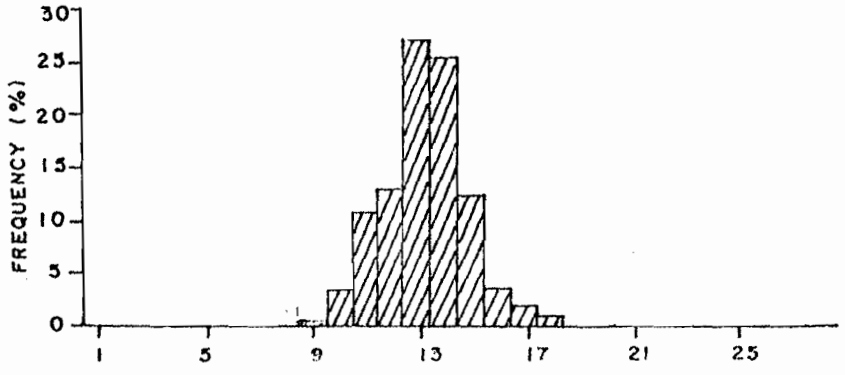

Fig. 3 : Length frequency distribution of Ethmalosa fimbriata from gill net fishery in inner Cross River estuary

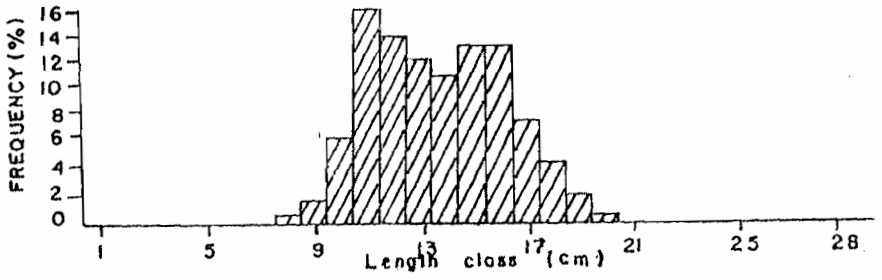

Fig. 4 : Length frequency distribution of Ethmalosa fimbriata from purse seine fishery in inner estuary of Cross River.

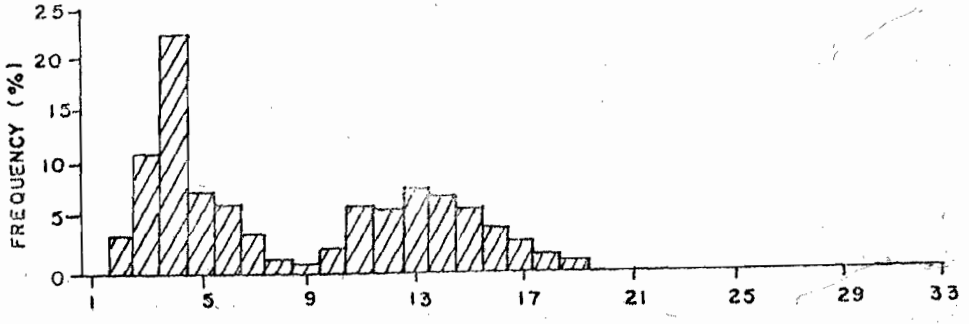

Fig. 5 : Length frequency distribution of Ethmalosa fimbriata in the Cross River

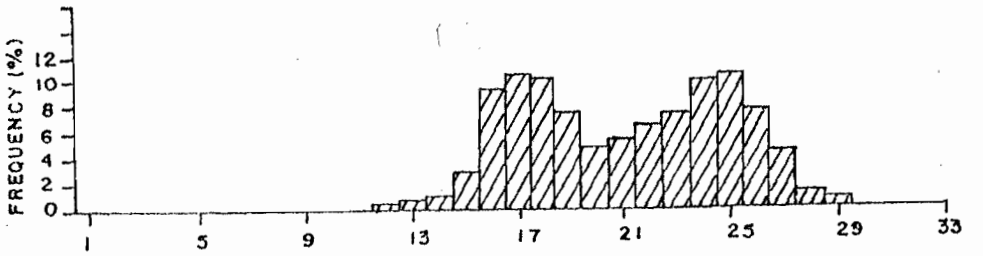

Fig. 6 : Length frequency distribution of Ethmalosa fimbriata from the coastal waters adjacent to the Cross River estuary

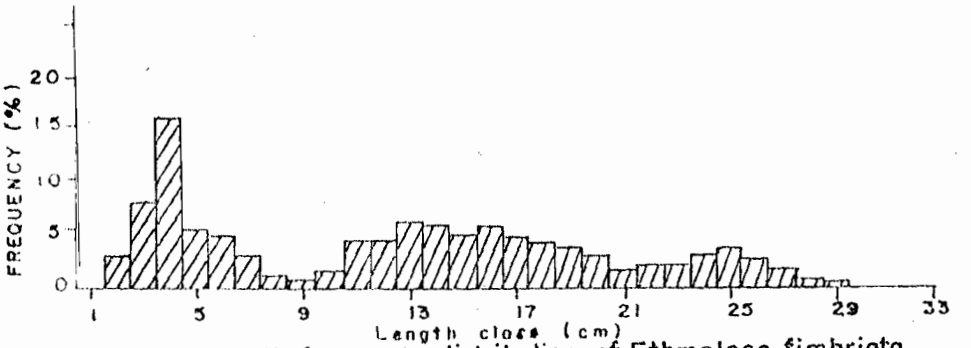

Fig. 7 : Length frequency distribution of Ethmalosa fimbriata in the Cross River estuary and adjacent coastal waters

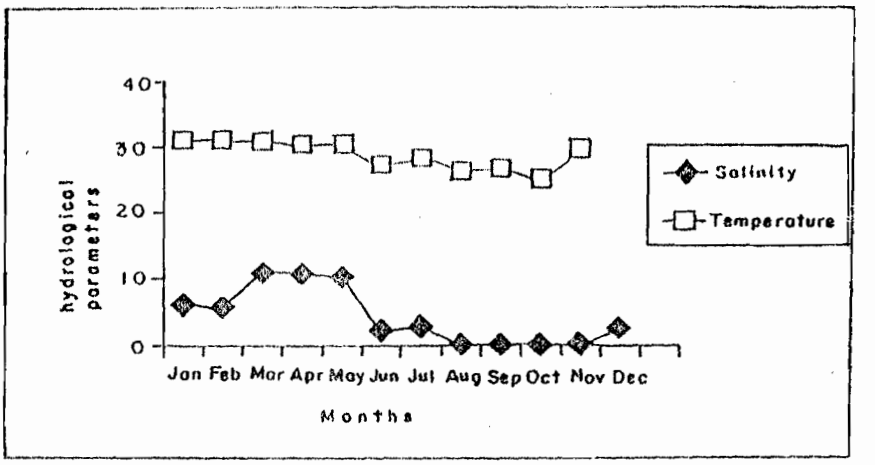

Fig. 8 : Salinity and temperature of the Cross river Estuary in 2000

Fig 6 shows the length composition of purse seine catches from the coastal waters. The size composition ranged from 12 cm group to 33 cm group. There were two modal classes of 17 cm and 25 cm. The frequencies of these modal classes were 10.6 % and 10.3 %, respectively. The 12 cm group had a frequency of 0.1 % while the 33 cm group had a frequency of 0.02 %.

Pooled data from both the estuary and coastal waters, (Fig. 7), showed three modal classes of 4 cm, 13 cm and 25 cm. The frequencies were as follows: 2 cm group: 3.0%, 4 cm group: 16.1 %, 13 cm group: 5.8%, 25 cm group: 3.2 % and 33 cm group: 0.01%.

The oceanographic parameters of temperature and salinity are shown in figure 8. The salinity of the estuary was depressed during the rainy season. The highest salinity value was 10.7 ‰ in March while the minimum value of 0.03 ‰ was

recorded in the month of August. The highest temperature of 31° C was recorded in January and February while the lowest temperature of 25° C was recorded in the month of October.

DISCUSSION

The study has revealed that only post-larvae and juveniles of *E. fimbriata* are found in the inshore waters of the Cross River estuary. Both the artisanal gill nets and the purse seine fisheries caught *E.fimbriata* of the same size composition in the inner estuary. Thus the addition of the purse seine samples to the total is justified and enabled objective evidence to be obtained for the supposition that the gear from the artisanal fishermen were selective against bonga of the larger sizes.

There were two modal classes in the estuary. Bonga individuals in the estuary represented two of the three modal classes mentioned by Fagade and Olaniyan, (1972) and Salzen (1958). Both observed three modal classes of 4 cm. 12 cm and 27 cm, in Lagos Lagoon and Sierra Leone River estuary respectively. They described the first two groups as juveniles. In the present study, the modal classes were 4 cm and 13 cm in the estuary, these represented the juveniles. *Ethmalosa fimbriata* of larger size groups inhabit the coastal waters. The two peaks seen in Figures 5 and 6 represent the feeders, ranging from 12 cm to 21 cm and the spawners ranging from 22 cm to 33 cm in length. From the month of May, the purse seine catches contained an increasing number of juveniles in their catches from coastal waters because the juveniles were migrating from the inner estuary seawards. When the data from both the estuary and the coastal waters were merged, three peaks of 4 cm , 13 cm and 25 cm emerged (Fig.7). The three peaks represent the post-larvae, the juveniles and the adults. This is in accordance with the observations of Fagade and Olaniyan (1972) and Salzen (1958) in Lagos Lagoon and Sierra Leone River, respectively.

Personal interview of the artisanal fishers revealed that they sometimes catch very few adult bonga in the inner estuary. There may be occasional straying of adult bongas from the coastal waters into the estuarine environment possibly for increased feeding activity. Such feeding activity is increased after spawning. Friedland (pers. Comm.) mentioned that adult Atlantic menhaden, *Brevoortia tyrannus,* do stray occasionally from the Gulf of Maine into the York River of United States of America.

It is worth noting that there is a progression in the size of bonga as one moves from the outer estuary upstream. Post-larvae, which are the young fish between the larval and the juvenile stages, were caught in the outer estuary while the juveniles were caught in the inner or central estuary. This is an indication of migration, which is from the sea estuary-ward. Migration of larvae and juvenile toward the estuary is feeding in purpose. Since the post-larvae and juvenile stages of bonga are found in the Cross River estuary it is concluded that the estuary is a nursery ground for *E. fimbriata.*

Adult bonga, both the fecund females and those with running eggs and males with running milt, were found in the catches from the coastal waters. There was none found in the outer estuary or inner estuary to a number, which can even be termed as spawning congregations. This observation coupled with the size increment as one moves from the outer estuary into the inner estuary provides an indirect evidence that *Ethmalosa fimbriata* spawns in the coastal waters and not in the creeks and rivers.

The reason for the high productivity of the Cross River estuary is obviously the rich mangrove flora that adjoins the estuarine coastline. Mangroves have been known as habitat for juvenile phases of commercially important fish, gastropods and bivalves, shrimps, etc. (Farnsworth and Ellison, 1997). Mangrove provides the detritus, which fertilizes the estuarine waters for the growth of planktonic food organisms, which form the major food of the juvenile bonga. Fagade and Olaniyan (1972) observed diatoms and zooplankton in the stomach of bonga of size, 3.5-6.9 cm in Lagos lagoon. They mentioned *Biddulphia* and *Coscinodiscus spp* as the major components of phytoplankton. Blay and Eyeson (1982) reported that the stomach of bonga caught in the estuarine water of Cape Coast contained mainly phytoplankton, protozoa, sand grains and detritus.

Diatom species of the genus *Coscinodiscus spp, Ditylium thermalis* and *Biddulphia* spp formed the major food organisms. Diatoms have been reported to be the dominant phytoplankton in Cross River System (Moses, 1983; Nawa, 1982). Abundance of algae, diatoms and other planktonic organisms provide ample food supply for the teeming population of bonga juveniles making Cross River Estuary a nursery for them.

In view of this crucial role of the estuary in the life history of bonga, the conservation of the

mangrove forest adjoining the coastline is of utmost importance. Since they provide the habitat and nursery for the juveniles, at certain times of the year, anthropogenic activities that impact on the estuarine ecological system should be checked. For instance the boat seine fishery that targets the post-larvae of size 2 cm to 8 cm should be discouraged. Cutting of the mangrove wood should be regulated.

Throughout the study period, the modal class of the gill net catches remained 13 cm while that of the purse seine was 11cm. Also the purse seine caught wider size range. In purse seine, more of the smaller juveniles are caught as well as the bigger fish. Therefore purse seine should be banned from exploiting the resources in the estuary. However, the advantage of purse seine fishery is that the samples are more representatives of the various size groups and therefore provide more information on the size composition of any species than the gill nets. It is suggested that where possible purse seine catches should be used for length frequency studies and population studies to minimize the bias created by gill net selectivity.

In his classification of estuarine species, Dando (1983) identified one of the classes as marine species that use estuaries as nursery grounds. McHugh (1967) noted that marine species which use estuaries, as nursery grounds are often the dominant members of Atlantic estuaries. Our study confirm this proposition and has identified *Ethmalosa fimbriata* in this group of marine species.

CONCLUSIONS

The coastal waters off Cross River act as both feeding ground and spawning ground for *Ethmalosa fimbriata.* Cross River estuary supports the population of post-larvae and juvenile of *E. fimbriata.* These stages in the life history of bonga are very crucial to the fishery, since recruitment depends on their survival, which in turn depends on the perturbation-free ecological system and proper management of the macro- and micro- flora of the estuary.

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